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Combat Crew

strategic air command

★★★★

AUGUST 1976

Combat Crew

strategic air command

FLARE

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OUR COVER

Key men in safe strategic air operations, SAC's skilled boom operators provide an essential function in today's strategic air power. Pictured is boom operator TSgt Phillip J. Short, 160 AREFG (near) and instructor boom operator MSgt Stanley E. Fulkerson, formerly of the 32 AREFS.

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Brig Gen C. R. Denniston, Jr.

SAC IG SAFETY INSPECTION

The inspection system is designed to evaluate all functions and activities of a unit. A prime objective of this system is to appraise the effectiveness and economy of safety programs. Although each SAC IG team will have at least one full time primary safety inspector, SACP 123-1, "The SAC Inspector's Guide", tasks each inspector with evaluating safety within his area of responsibility to assure that combat capability is not being wasted by accidental loss. The safety inspection should identify those units not supporting the accident prevention program.

The purpose of the accident prevention program, established by AFM 127-1 and supported by SACR 127-2 and related Air Force and SAC publications, is to furnish a safe environment for the accomplishment of the unit mission and to provide for the identification and elimination or reduction of accident causes. It gives standards and guidelines for the accomplishment of the basic elements of a safety program; *education and training, engineering, enforcement, investigation and reporting,* and *evaluation.*

Education and training covers many activities designed to promote safety awareness, including formal courses in support of AFR 50-24 requirements, informal training such as that given to additional duty safety personnel, and information provided for bulletin boards, shop talks, and meetings. *Engineering* includes the safeguarding of existing facilities as well as preconstruction planning. Enforcement of established practices and procedures is essential to program success. *Investigating* mishaps and *reporting* cause factors are primarily concerned with identifying hazards in unsafe conditions or unsafe acts. *Evaluation* provides the data needed to identify problem areas or weaknesses in program content, management practices, or personnel compliance.

The safety inspection rates the elements of the accident prevention program under three general areas; *command support, program management,* and *program compliance.*

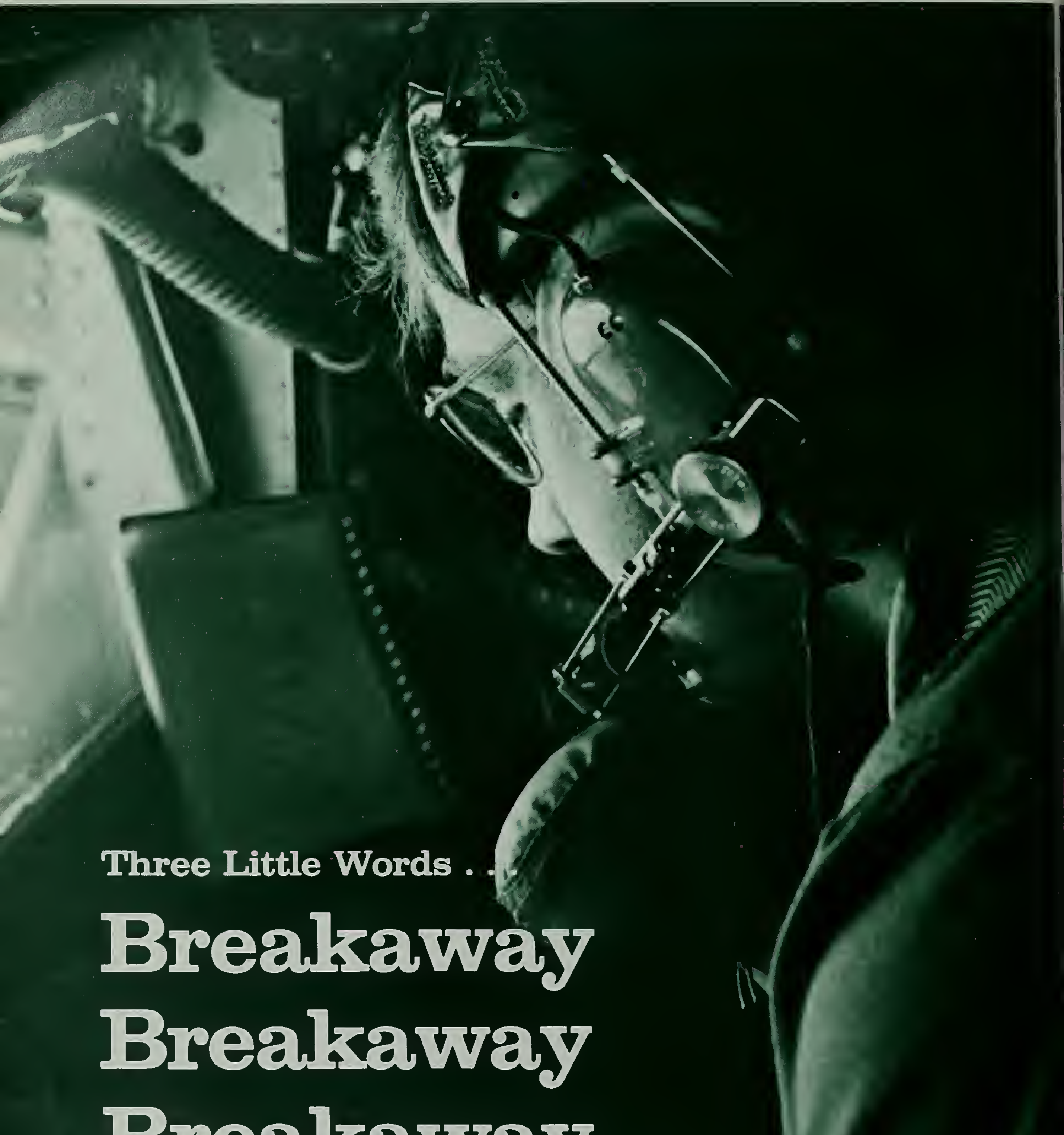
Command support encompasses commanders and supervisors at all levels of the organization; their involvement in providing the necessary elements of a safety program for their people, the emphasis and concern they show for establishing a safe environment and dealing with problem areas, and their use of the educational material provided by the safety staff.

Safety program management evaluates how well safety personnel are satisfying program requirements and how well the program meets the needs of the organization. It includes the dissemination of accident prevention material, the effectiveness of surveillance activity such as visits and inspections, the investigating and reporting of mishaps and hazards, and the appropriateness of corrective action and follow-up procedures.

Safety program compliance looks at how well individuals understand and comply with safety requirements and how effectively supervisors require adherence to these standards.

Although the real measure of success for a safety program, "the accidents that never happened", cannot be determined, the inspectors review records and program material, observe present conditions and activity, and talk with personnel at all levels in an attempt to obtain a true picture of the safety effectiveness within the unit. As in all inspection efforts, the goal is the improvement of the program through the identification of problem areas and the recognition of outstanding techniques or procedures. For the safety program, these improvements can result in the saving of our human and material resources.

It is my hope that this general summary of the SAC IG safety inspection will improve your understanding of our requirements and objectives and provide a basis for assisting in the evaluation of your unit's accident prevention program.★



Three Little Words . . .

Breakaway
Breakaway
Breakaway

SMSgt Billy G. Hall
70 AREFS
Grissom AFB

How often have you heard those three little words, "Breakaway, Breakaway, Breakaway?" With the lower age and experience level we now have in the SAC crew force these words are becoming commonplace.

The need for emergency breakaways could be reduced by proper radio transmissions to inform receiver pilots of corrections to stay within the air refueling envelope. All of the blame should not be placed on our younger boom operators. Many of the old heads have used, are using, and are teaching improper procedures and/or techniques. Throughout my career as a boom operator I have often heard the phrase, "You're approaching a (whatever the case might be) limit." According to T.O.1-1C-1-3, page 1-4, "voice transmissions will be held to an absolute minimum required during rendezvous and air refueling." Only once does the tech order say to inform the receiver that he is approaching boom limits. This is when he is demonstrating the limits (T.O.1-1C-1-3, page 1-7). It does state, "Inform receiver of corrections necessary to stay within the air refueling envelope unless radio silence is being utilized." The book also says that, "The receiver may request verbal assistance from the boom operator in maintaining proper contact position." When verbal assistance isn't requested the receiver should be able to follow the pilot director lights. If it is apparent that he is having difficulties then, by all means, assist him. The secret is, don't say too much; only what is necessary and required.

Before the many manual changes and the subsequent removal of explicit information, the book read something like this; "While in contact, in order to keep the receiver within the envelope limits, the boom operator will give the distance to move preceded by the direction; i.e., if the receiver is approaching an outer limit, he would say *Forward* (the required feet to get him to the mid-point). The mid-point of the telescoping limits would be 12 feet (halfway between the inner limit of 6 feet and the outer limit of 18 feet). So if the receiver was at 16 feet extension, the boom operator would state, *Forward four.* The boomer should make all corrections to the mid-point.

As stated previously, the mid-point in telescoping is 12 feet. For azimuth we all know this to be zero degrees for most receivers. And for elevation, normally 30 degrees, but for fighters the desired elevation is around 32 to 34 degrees because of the reduced upper limit. If the boom operator gets these mid-points fixed in his mind then proper corrections should come automatically with no confusion as to the desired positioning of the receiver.

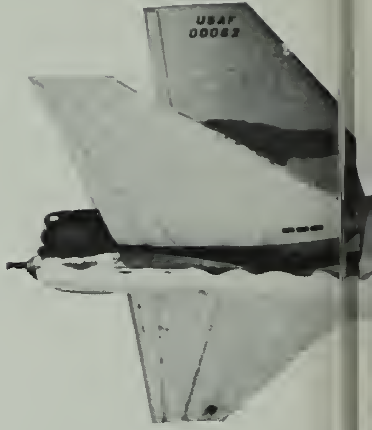
With no fixed mid-point in mind overcorrections are often used. These can be very confusing to the receiver pilot. Many boomers correct the receiver from one extreme to the other. For example, the green area for telescoping is 9.1 to 15.3 feet, and as the receiver moves in to around 10 or 11 feet, the boom operator gives him a "Back five" correction. This will put him near or out of the green at the opposite end. Besides this, he was in the green in the first place and he might question the correction if he is observing the pilot director lights. This is bad practice and will buy the boomer a writeup on a standardization ride. To preclude this problem and to alleviate confusion in the mind of the receiver pilot, aim for the bull's-eye — mid-point. If the mid-points are firmly implanted in the boomer's mind this won't happen or shouldn't happen. Corrections should be made to the mid-point. To become standardized, corrections must be made to the mid-point!

As we all should know by now, the varied uses of terminology can lead to confusion of the receiver pilot. Another example of this confusion occurs when the receiver is riding high in the envelope and the boom operator gives several down corrections without response from the receiver. Suddenly the receiver moves down and forward and the boom operator, who is not familiar with the mid-points and terminology, shouts, *Back up!* What is the receiver pilot's instinctive move? To return to the position which he just departed by rapidly climbing. This could cause some embarrassment to say the least. Worse yet, it could lead to boom and/or receptacle damage, or ultimately, a mid-air collision. All from the improper use of terminology.

If all boom operators used the proper air refueling terminology, incidents and accidents during air refueling would be reduced. Get into the tech order. Read it religiously. Learn the proper terminology and use it in your radio transmissions. Remember, the word is standardization. If the book is followed to the letter then standardization will happen. Those three little words cannot or should not be eliminated from the terminology, (they are for emergency use) but situations leading to their use can be avoided by the correct use of proper terminology.

In-flight refueling incidents and accidents cost tens of thousands of dollars each year. With less confusion in radio transmissions by the use of proper terminology, these figures can be substantially reduced.

SRAM



a potent weapons system . . . and a lot more!

Capt Stephen M. Ray
17 BMW
Beale, AFB

The final operational phase-in is complete, and the Strategic Air Command (SAC) combat crews who fly the B-52G and H model aircraft have been provided with a superlative weapon system: the AGM-69A Short Range Attack Missile (SRAM). Due to the sophisticated inertial avionics inherent to SAC's FB-111 aircraft, the introduction of the SRAM into the inventory has not had the impact for the fighter-bombers that it has had for SAC's heavy bombers. Nevertheless, this new missile is an effective and accurate weapon addition to any carrier aircraft.

But let's take a look at the SRAM from another viewpoint — as an important aid to the B-52's primary mission of navigating to and bombing of enemy targets. Once the SRAM inertial navigation system has been aligned after takeoff, the SRAM digital computer can provide the B-52 crew with a wealth of information. However, before discussing the content, availability, and significance of this information, a brief review of the AGM-69A and its associated equipment is in order for those readers with no prior exposure to the SRAM weapon system.

The B-52 can carry up to twenty AGM-69A missiles, eight internal and twelve on external pylons. Each missile is 14 feet long and 18 inches in diameter. The nuclear warhead missile is inertially guided and is powered at supersonic speeds by a two-pulse, solid fuel rocket motor. But this is only half the story. The SRAM Carrier Aircraft Equipment (CAE) provides prelaunch control and monitoring of missile power, alignment, thermal conditioning, targeting intelligence, and launch and jettison control. It is the CAE which has come to be the B-52 navigators' truly valuable aid.

As mentioned, the SRAM system must be powered once airborne. Slightly more than one-half hour later, the SRAM Inertial Navigation System is initialized in heading,

velocity, position, and altitude with B-52 Bombing and Navigation System (BNS) signals. This is accomplished by acquiring the first checkpoint fix. Additional checkpoints are acquired during flight to keep the system position and velocity data updated. However, once the system has been initialized, it is essentially an independent navigation system.

What this independence means to the B-52 navigator is that if BNS malfunctions should occur, the SRAM navigation system information can be used to prevent temporary disorientation which often occurs in these cases. SRAM information is readily available on the Mission Data Display Panel with the use of the Mission Data Control and Status and Control Panels located between the navigator and radar navigator. (See Illustration 1)

The most obvious data available is the direct readout of the geographic coordinates and true heading of the aircraft as computed by the CAE. However, the CAE can tell the navigator much more. For example, after a couple of position updates from the BNS, a system instruction code can be used to check the alignment status of the CAE — important information if BNS heading or stabilization is inaccurate.

The SRAM system can also provide an indication of BNS malfunctions by way of the VEL/BARO NOGO Light on the Status and Control Panel which indicates deviations in velocities, barometric altitude, or aircraft pitch and roll tolerances. The point is that the bright yellow light in front of the navigators may be the first noticeable sign of BNS problems.

Another way in which the CAE can be utilized is in the determination of wind direction and velocity in either of two ways. The simpler but less accurate method is completed by tracking a geographic point within 17½ miles of the aircraft and simultaneously depressing the memory point mode of the BNS and the Load

Continued on Page 26

SELM TEST

1Lt Thomas L. Roush
90SMW F.E. Warren AFB

The launch conductor's voice on the telephone was calm, but with just the slightest trace of tenseness.

"Bravo and Delta capsules, turn keys on my mark."

"Three"

"Two"

"One"

"Mark"

In two launch control centers, each a sealed, flourescent-lit humming capsule buried sixty feet under the Great Plains, four specially trained missile crew members turned four keys.

Normally, this significant act would have sent fifty nuclear-tipped Minuteman III missiles roaring out of their silos and heading for their pre-assigned targets.

On this day, however, and on other days like it at other Minuteman Wings, no Minuteman missiles were launched. This day, elements of the 90th Strategic Missile Wing at F.E. Warren AFB were participating in a SELM test.

SELM — Simulated Electronic Launch Minuteman — is SAC's ongoing program designed to test various aspects of the Minuteman weapon and ground systems. This program is nicknamed Giant Pace.

It is the safest, surest, and least expensive method SAC has devised to test the ability of our Minuteman missiles to launch as designed.

The simulated electronic launch of a "live" Minuteman missile is an operation which may sound a little spooky. Some explanation is required.

Weeks before the simulated launch, Missile Maintenance Team (MMT) members at the 90th Wing depostured the eleven missiles involved in this year's SELM. This in itself is a major operation involving many man-hours. Each missile's re-entry system — the nuclear warhead — is removed and convoyed back to the support base. To accomplish the removal, the MMT troops must crank open the 110-ton launcher closure door, hoist the warhead into a specially equipped van parked over the launcher, secure it, and crank the launcher door closed. The entire operation is accomplished in strict compliance with T.O. procedures and under the supervision of Quality Control and Evaluation (QC & E) teams.

After the warhead is removed, the maintenance team places a simple sheet of plywood on top the missile. "Black boxes" placed on top the plywood are then connected to the missile. These boxes electronically simulate the re-entry system.

The removal of the warhead, however, is only the first of many safety procedures accomplished during preparation for a SELM test. Additionally, maintenance teams install a total of nine safing pins at various points on the missile itself.

Finally, the eleven missiles involved in SELM must be completely isolated from the other thirty-nine missiles in the squadron.

One of the great strengths of the Minuteman III system is the redundant interconnectivity of all fifty missiles to the five launch control centers (LCC's) in each squadron. The interconnectivity was designed to insure that even after a heavy first attack, when one or more of the LCC's might be destroyed, two of the LCC's would be able to monitor and launch all fifty missiles.

Obviously, during a SELM test, the two participating LCC's and the eleven specially configured missiles must be completely isolated from the other three LCC's and the thirty-nine missiles which are maintaining their EWO alert.

Isolation is achieved in two ways — physically and electronically. First, members of Electro-Mechanical Teams (EMT) — who again have been specially trained for SELM — physically disconnect the cables which connect the SELM LCC's and missiles to those that remain operational. In effect, we now have two separate "mini" squadrons. Second, the SELM missiles and LCC's have codes installed which are different from those installed in the operational missiles and LCC's. In layman's terms, the two mini-squadrons will be speaking two different coded "languages" and thus — even if they are still physically connected — could not "communicate" with each other. Combat Targeting Teams (CTT) perform this operation at each launch facility. CTT members shut down each missile and erase all coded data. Then, working in conjunction with the missile crews miles away in the LCC's, the CTT members start up the missile and feed new test data into it.

At this point, work on the missiles is essentially complete. What follows are two separate inspections of each missile and its launcher, performed by separate inspection teams. Absolutely nothing is overlooked. Every pin, switch, and cable must be properly configured.

Finally, the missile crews which have been selected and trained for the SELM test become involved. The first major procedure is a series of three isolation tests. These verify that the two "mini-squadrons" are, in fact, totally isolated from each other. The SELM crews send a particular all call command to their test missiles. The crews in the operational (the non-test) LCC's verify that none of their missiles respond to this command.

Following their checklists precisely, (in fact, word for word) the SELM crews perform a total of three such isolation tests on three different days.

After the first isolation test, a complete "dry run" of the simulated launch is performed. Hopefully, this will spot any weak links in the communication net or any other minor problems.

Following the dry run, an inspection team will perform a last look inspection, at which time all components will be certified ready for the test.

The simulated electronic launch is actually in two parts. The first part — Ground Test Day — consists of a second isolation test followed by two separate key turns by the crews in the launch control centers. Two separate key turns, at two different times, permits us to test different characteristics of the weapon system. The idea is to verify that, under particular conditions, missiles will accept enable commands and launch exactly as they are designed to do.

The second part of the test is conducted three days later, on the Airborne Test Day. Once again, the missile crews perform isolation tests, followed by two simulated launches. These simulated launches, however, test the ability of the airborne launch control center to transmit enable and launch commands, via radio, to the missile launch facilities. Once again, two simulated launches permit verification of different capabilities of the weapon system.

Following the airborne test, members of the various specialized maintenance teams begin deposturing the missile sites from their SELM alert, reconnecting cables, and restoring the test LCC's and missiles to their normal EWO alert.

From the day maintenance teams receive their first training, to the day when the last missile is returned to its normal EWO alert, the SELM test at the 90th SMW takes about seven

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TURBULENCE TECHNIQUE

Editor's note: The following article includes highlights of a technical paper on turbulence technique presented to the Flight Safety Foundation Professional Pilot Conference by John B. Clark, Captain, American Airlines ATP/CFIT, DC 10, B707, 23,000 hrs. The opinions expressed in this article are those of the author and are not to be construed as the views of American Airlines, Inc.

TECHNIQUE is the same whether in thunderstorms or clear air turbulence, according to American Airlines Capt. Jack Clark.

Clark, author of several articles on his personal research into the problems of flying in turbulence dating back to 1955, presents views differing in some respects to currently accepted industry theories. He points out, however, that research of Russian aerodynamicists generally confirm his findings.

Upsets occur primarily in thunderstorms. There is a clear pattern in upsets involving propeller-driven planes. Entry into a violent updraft triggers use of full airplane nose-down elevator. This quickly pitches the airplane into a low-speed deep dive with a negative angle of attack stall. The very high drag delays or prevents any increase in airspeed. The stall is broken by reversing the elevator input to airplane nose-up.

Jet upsets show a slightly modified pitch axis pattern. With swept, tapered and flexible wings the jet has different stability characteristics. It has much less elevator authority plus a large slow-moving horizontal stabilizer to control about the pitch axis. Again, the triggering action is a violent updraft and there is an unstable pitch-up. Evidence shows an overreaction with airplane nose down elevator and stabilizer, a high speed negative *g* dive. With the mistrimmed stabilizer "locked in," airplane nose-down opposes the quickly moved airplane nose-up elevator.

Pilot training, improved instrumentation, increased turbulence penetration speeds and a stabilizer modification have contributed to a dramatic decline in incident reports, Clark confirmed. His suggestions are given to further improve pilot training programs.

Clark urges "creative discontent" with conclusions of some turbulence upset researchers and techniques based on these ideas. He says a distinct recurring pattern emerges from upset incidents and that an accurate script could be written for the next five that will occur.

Two principal types of turbulence are CAT, clear air turbulence, and the disturbed air of convective clouds, thunderstorms in the worst form. Major differences exist between the two in gust/draft characteristics as to frequency, duration and intensity. Trouble in CAT is usually associated with a surprise entry in an unprepared state. In most penetrations of thunder storms ample warning is available, but though advance preparations have been made, records show many out-of-control incidents.

Much emphasis has been placed on high altitude jet performance but records show most upsets occurring at 18,000 to 20,000 ft or lower, Clark stated.

RECOMMENDATIONS FOR FLYING IN TURBULENCE

Clark's recommendations for proper technique in turbulence are:

Target airspeed: The figure furnished by the manufacturer is the

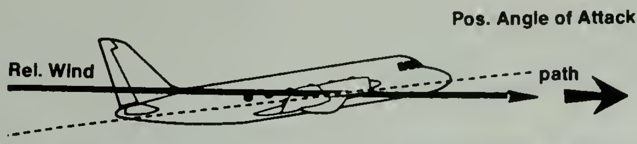


Fig. 1. Level flight in stable air at reduced airspeed. Airplane mounted arrow indicates relative wind source.

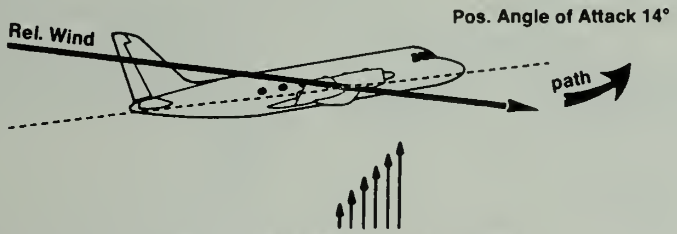


Fig. 2. Updraft entry. Heavy positive *g*. Airspeed decreasing.

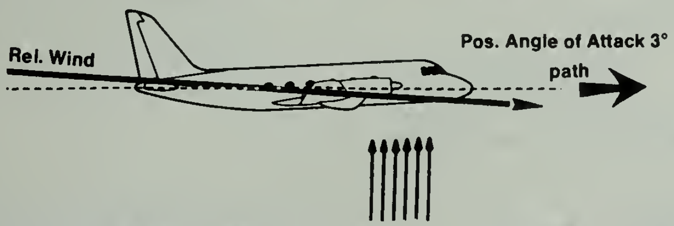


Fig. 3. Updraft continues. Forward stick lowers nose rapidly. Small positive *g*. Low airspeed.

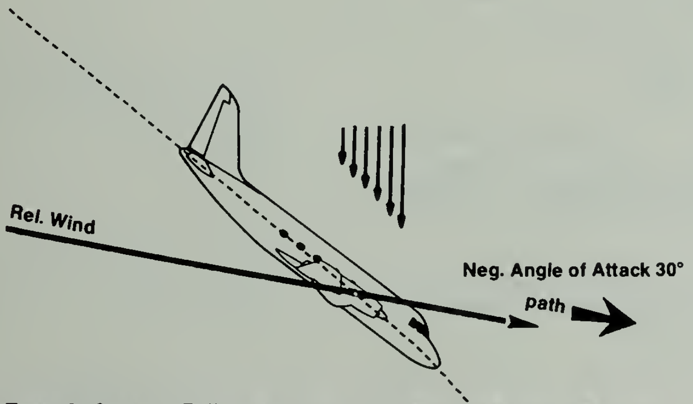


Fig. 4. Downdraft entry. Full forward stick still held. Negative angle-of-attack stall with low airspeed. Buffeting evident.

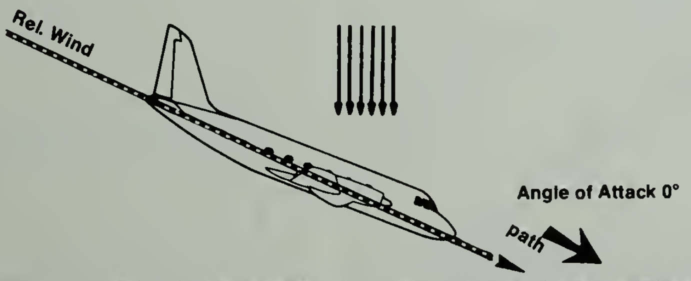


Fig. 5. Back stick and stall is broken. Airspeed increased rapidly in streamlined dive.

best compromise between the high speed, good control, maximum stress entry and the low-speed, poor-control, danger-of-stall, minimum-stress entry.

Preparation for entry: Level flight is preferred with power set to produce target air-speed. Crew should decide on a safe pitch-attitude envelope for their plane. Airplane should be trimmed for neutral control forces around all axes. Lighting should be adequate and loose articles secured. Crew duties should be specifically assigned.

Attitude control: Pilot's primary attention should be given to keeping pitch attitude within the predetermined acceptable pitch envelope appropriate to the airplane type. Flight within this pitch envelope should be maintained in a soft manner by smooth control movements. Artificial horizon is the most valuable instrument for this purpose and an angle-of-attack indicator is extremely valuable if available.

Airspeed control: Pitch and power changes should be kept to a minimum. If an undesirable airspeed trend develops, small power and attitude changes may then be considered.

Altitude control: Mentioned last, and unless terrain clearance is a problem, of least importance is altitude. If it is difficult to maintain attitude, airspeed and altitude, the first expendable should be altitude.

Massive research into the problem was triggered by a rash of jet upsets in 1963 and 1964. Similar though not so well publicized upsets had occurred with prop planes in the fifties. Clark points out that he wrote of an evident pattern to the incidents at that time, 1955. His later research has shown some portions of the jet upset pattern of the sixties coincide exactly with the propeller-type upsets of the fifties. Other parts of the pattern are significantly different and there are important aerodynamic and human response reasons for these differences.

Significant factors and differences should be noted. Propeller type planes have very effective elevators and ability to change pitch attitude

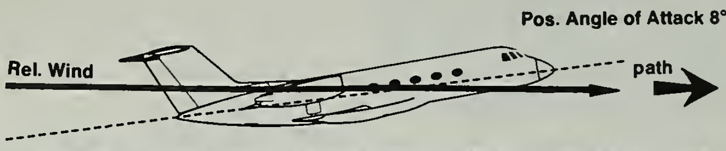


Fig. 6. Level flight in stable air at reduced airspeed. Airplane mounted arrow indicates relative wind source. Jet was in climb attitude but is illustrated as level for comparison of prop and jet patterns.

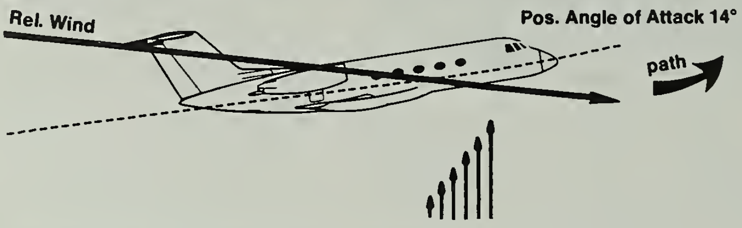


Fig. 7. Updraft entry. Heavy positive *g*. Airspeed decreasing.

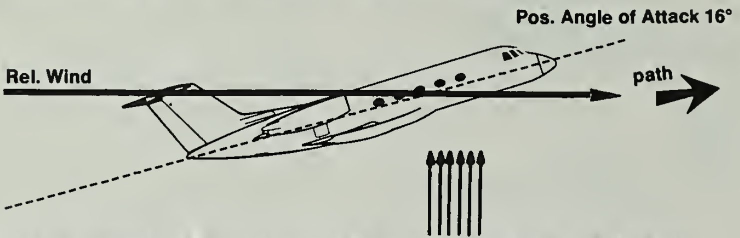


Fig. 8. Updraft continues. Forward stick used as nose pitches upward. Airplane nose-down stabilizer used. Heavy positive *g*. Low airspeed.

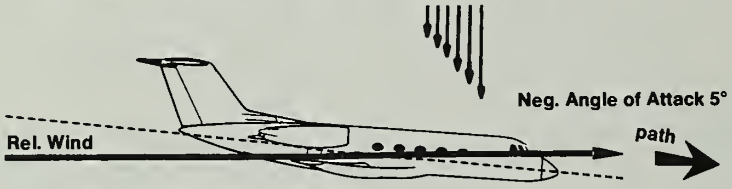


Fig. 9. Downdraft entry. Path and nose moving downward. Start of negative *g*. Stabilizer nearing its limit for airplane nose-down.

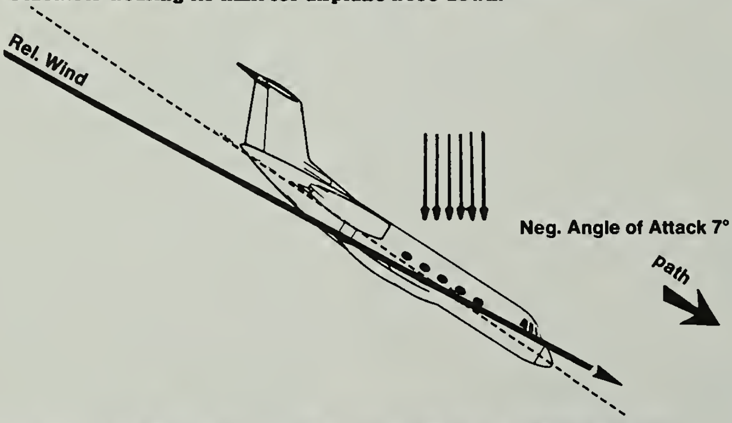


Fig. 10. Negative *g* builds. Airspeed increases rapidly. Stick pulled full back opposing full airplane nose-down stabilizer. Altitude loss great in recovery from massive mistrim situation.

rapidly. Elevators on jet transports and some smaller executive jets do not provide such high rate of pitch change. Elevator effectiveness ratio between jet and props is as low as 1:3 to 1:7 in some flight regimes.

Engines on most prop planes are in same horizontal plane with CG. Power changes do not materially alter pitch. Some jet engines are located below the wing, well below the horizontal plane of CG. Power changes would bring about pitch changes.

Prop types have little wing sweepback. Most jets have sweptback, tapered, flexible wings.

Conditions for entry into rough air: Reference to figures 1 and 6 show the aircraft at a higher than level angle of attack. This attitude corresponds to level flight at reduced airspeed, or in the case of the jet, in a climb. Virtually every jet upset has occurred while in the climb portion of the flight, Clark has observed. Power was stabilized.

Updraft entry in both cases, figs. 2 and 7, was the same. Airplane entered a severe updraft which radically increased its angle of attack. Flight path curved upward in the updraft. Positive *g* load increased materially. Temporarily flight path and relative wind were not directly opposite to each other. Airspeed decreased.

Pilot response: In Clark's opinion virtually every pilot's initial reaction when entering a violent updraft is to use forward stick, the only variation being how much and how fast it is applied, and how long it is held.

Differences in prop and jet reaction become visible in figs. 3 and 8. At this point positive acceleration coming from the steep gradient updraft outweighed negative acceleration normally associated with a rapid nose-down pitch progression, leaving a net *g* load acceleration on the positive side. If attention had not been paid to the artificial horizon the pilot would have been unaware of nose-down pitch progression, in the case of the prop plane.

Clark sees a new element in the pattern with the jet. Considerable evidence available to him, he says,

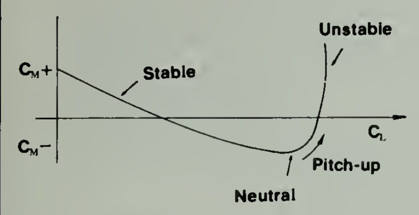


Fig. 11. Pitch-up Curve.

C_M+ = Airplane nose-up pitching moment.

C_M- = Airplane nose-down pitching moment.

C_L = Coefficient of Lift.

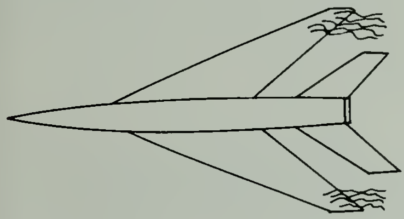


Fig. 12. Typical swept wing jet will experience separation or wingtip stall first.

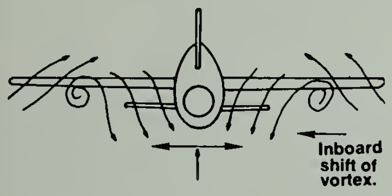


Fig. 13. Arrows indicate increase in local downwash at tail and inboard shift of vortex which occur at high angles of attack.

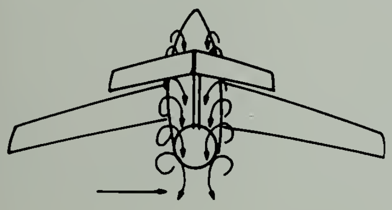


Fig. 14. Arrows show fuselage cross flow separation vortices and increase of local downwash at tail on T-tailed aircraft.

indicates that jet transports in violent updrafts actually pitched upward, slowly but persistently. This reaction is directly opposite to what most pilots have been taught to expect and indicates static instability. Static stability would cause the plane to pitch downward to maintain the same entering angle of attack. A much greater positive *g* force would be felt at this time by the jet pilot than by the prop pilot.

In the jet when the fully-deflected small elevator did not stop the pitchup in the updraft the pilot followed up with the large, slow-moving stabilizer to lower the nose. The airplane responded slowly to the additional nose-down stabilizer so that at the end of the updraft cycle the stabilizer was wound to its airplane nose-down limit. Fig. 9.

Over a short period of time one of three air movements would have taken place within the storm. Updraft might have continued, in which case plane would have continued its acceleration until stabilized within the draft and positive acceleration would cease. Or the plane could have flown out of the updraft into relatively calm air, removing positive acceleration. Finally, and most seriously, the plane could have flown out of the updraft and entered a strong downdraft, and for purposes of this discussion Figs. 4 and 9 assume this condition.

Draft reversal came as full forward stick was being held and brought about a situation unfamiliar to some pilots, negative angle of attack stall. Present was buffet, heavy negative *g* load and decreasing airspeed, even though the plane's pitch attitude was nose-down. Fig. 4.

Early transports experienced great damage from the negative *g*. Arm rests were torn loose and thrown to the ceiling with other debris. Oil went to the top of the reservoir and oil pumps experienced starvation. Lost oil pressure was indicated by red lights flashing and prop dome oil pressure loss allowed props to flatten and overspeed. Negative *g* should have been a cue to get off full forward stick, but at this time the pilot wanted more airspeed and tried to get it by continuing to push the nose deeper into the dive. This kept the plane in a negative angle of attack stall. Heavy drag present prevented an airspeed increase even against the pull of gravity.

Finally, recovery was made visually by pulling back on the stick after flying out of the clouds in a deep dive attitude. Airspeed built rapidly as soon as forward stick was released. Fig. 5. Some recoveries were made with back stick which brought about a streamlined, low drag dive and very high airspeed. Aerobatic pilots are quite familiar with the phenomena through outside loops, outside snap-rolls and inverted spins. These pilots know a plane can be stalled from any pitch attitude, positively or negatively, by aggravated control use.

Fig. 10 shows that as the nose-down rotation of the jet continued to a dive attitude airspeed began building rapidly. Clark reminds the reader that the rate of rotation, nose downward, had been slow in the jet. The fuselage centerline stayed approximately parallel to the flight path as both turned downward. Aerodynamically clean, the jet with a small negative angle of attack accelerated rapidly. Altitude loss is great, in part due to slowness of elevator to return to neutral.

Newer artificial horizons are much less likely to be misinterpreted than earlier models. The pilot will quickly recognize a dive attitude, negative *g* and increasing airspeed and will pull back on the stick to bring the nose up. Massive mistrim exists, however, with the slow-moving stabilizer at its limit asking for the nose to pitch downward and the fast moving elevator at its limit asking for the nose to pitch upward. This mistrim coupled with high airspeed could have caused the stabilizer jackscrew to jam, unable to move the stabilizer at all. Jackscrews have been found in full nose-down position in several jet transport accidents.

Designers of jet aircraft face many problems with static and dynamic stability without penalizing performance. Swept, tapered, flexible wings may show undesirable sharp stability curve reversal as the stall region is entered. A violent up-draft can put the aircraft into a region where the pitching moment would be positive, causing it to pitch-up into a still higher angle of attack.

Dominant problem in large jet transports designed for low *g* loads is aeroelastic-tip-unloading under posi-

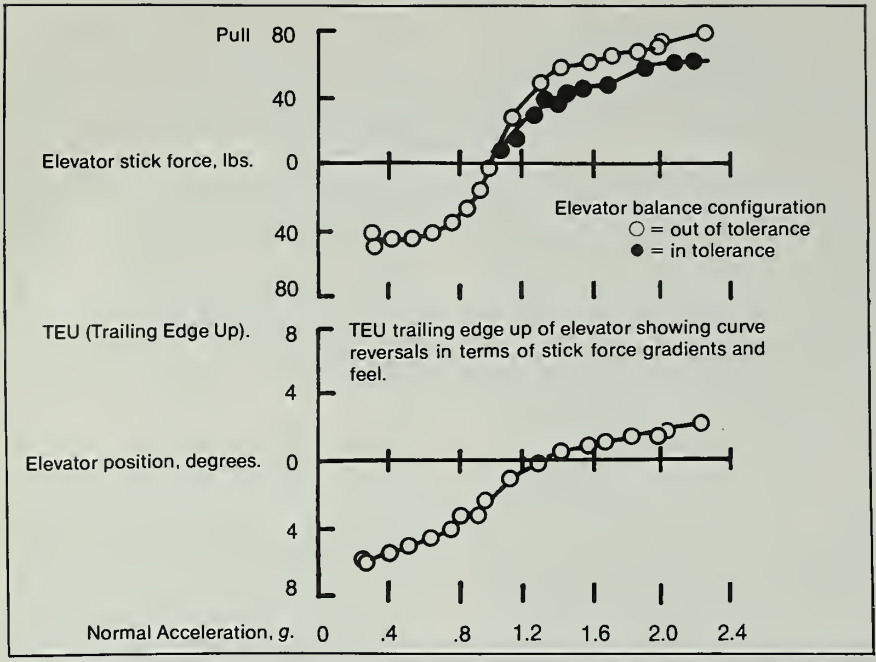


Fig. 15. Plot of longitudinal control maneuvering characteristics of a particular jet tested. Clark believes curve would reverse at high *g* forces. Northwest upset near Miami showed 3½ *g*; beyond limits of this curve.

tive acceleration. Flexing upward of the wing in an updraft or steep turn causes the tip to twist toward a lower angle of attack, giving away lift and moving center of lift forward, thus causing a pitch-up moment. If the wingtips stall first, vortices shift inboard and increase local downwash at the tail. At high angles of attack the fuselage can produce strong crossflow separation vortices which increase the local downwash on a horizontal tail placed above the fuselage. Fig. 11 through 14 illustrate these phenomena.

Severe "tailoring" of the wing has been done by designers to conquer the positive angle of attack pitch-up problem. When the angle of attack goes negative in the dive, however, "tailoring" seems actually to cause instability. A jet transport in a negative *g* dive could have a pitch-down problem associated with a negative *g* tip stall, and would come as the pilot is already struggling to recover from the dive portion of the upset.

Fig. 15 is a NASA research plot of longitudinal control maneuvering characteristics of a particular transport plane. Forces and accelerations run from positive *g* of 0.2 to positive *g* of 2.3. It does not cover accelerations of over 3.0 positive and negative which have been found on upset incident tapes. Understandably, Clark says, aerodynamicists are very interested in extension of these curves of stick force plots in each direction from those shown.

Clark points out that many published papers on stability speak only of jet planes with static stability. Some write off the upsets as PIO, *pilot induced oscillations.* The pilots supposedly are reacting against the jet's static stability in one draft just as an opposite draft is entered and the result is supposedly an oscillation.

Weathervaning pitch response of a jet transport is so slow most pilots cannot discern the direction of pitch, much less react to it in a drastic manner. Pilots are extremely careful about using airplane nose-up controls. They would not pull the airplane into the nose-high attitude so evident just prior to the upset, Clark believes, but they are not hesitant about lowering the nose.

Leading edge slats and slots, wing fences, wingtip washout, special camber treatment at wing root, warning horns, stick shakers and pushers are all used to try to solve the problem. Russians claim their Ilyushin IL62 has static stability in updrafts because of swept-forward wingtips and a stiffer wing. They also claim they use bobweights in the control system to improve pilot "feel." While there is much propaganda in their articles, Clark feels their technical ideas warrant examination.

Since 1964 some airplane models were modified to limit nose-down stabilizer trim available through the jackscrew and the accident/incident record improved dramatically. Other improvements have been added such as angle-of-attack indicators which encourage pilots to "think" angle-of-attack rather than exclusively of pitch attitude.

Clark illustrates pitch-up instability, or overload instability around the pitch axis, with the fact that many sweptwing MIGs were "killed" without firing a shot in the Korean conflict. As an evasive action the MIGs banked sharply. They pulled high *g* loads, causing an overload instability pitch-up on their T-tail fighters. With inadequate pitch-down control authority the pilots were forced to eject.

Clark concedes little or no disagreement exists that upsets usually involve; heavy positive *g* forces; nose-high attitude prior to a dive; steep dives with high airspeeds; negative *g* forces; elevator ineffectiveness at high Mach numbers in the dive; stabilizer mistrim, invariably in nose-down position.

He does point out, however, that other areas are questionable. For example the myth that jet upset is primarily a high-altitude, thin-air phenomenon. Records clearly show most upsets have occurred below 20,000 ft. Some pilots may have misconstrued the high altitude buffet boundary message so that the high altitude flight characteristics of the jet were viewed as the primary cause of upsets rather than a complicating factor in a already well-developed upset.

Many flight crews consequently plan their flights at uneconomical low altitudes to stay away from what they believe to be a danger area, even in smoothest of air. An airplane can buffet at low-airspeed high-angle-of-attack, or at high airspeed because of shock waves on the wing when near

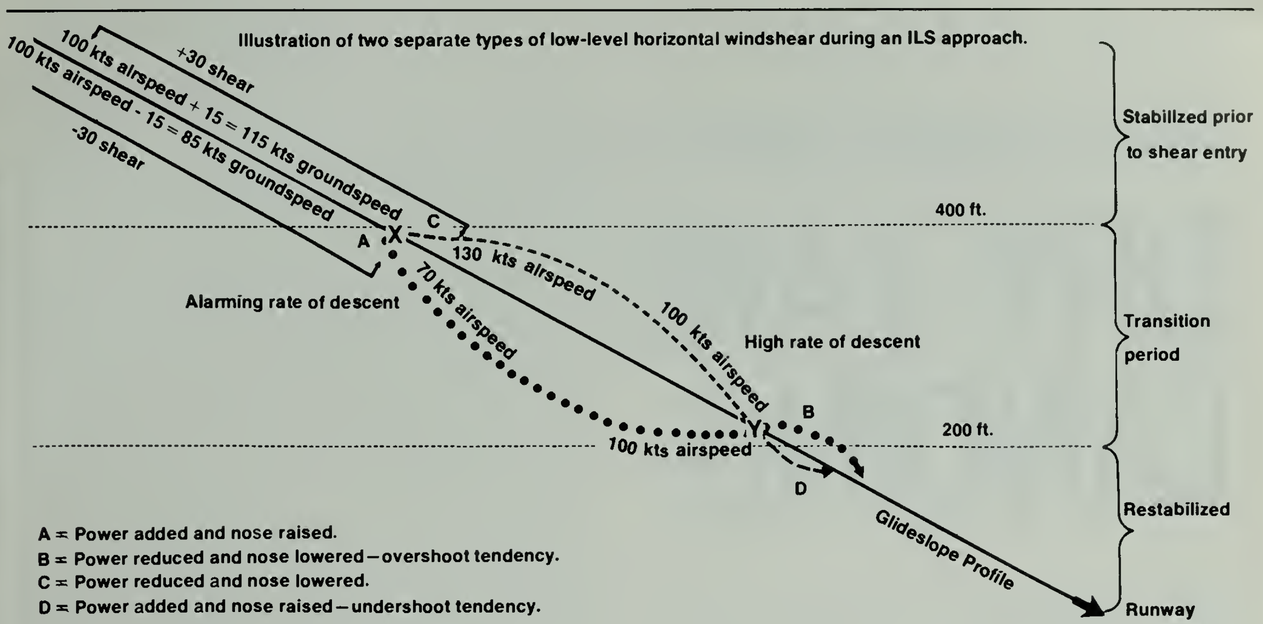


Illustration of two separate types of low-level horizontal windshear during an ILS approach.

A = Power added and nose raised.
B = Power reduced and nose lowered—overshoot tendency.
C = Power reduced and nose lowered.
D = Power added and nose raised—undershoot tendency.

Legend: .....= Path after a 30 kt loss of airspeed in a shear (headwind being encountered is 15 kt shearing quickly to 15 kt tailwind). These figures appear below glideslope profile.
-----= Path after a 30 kt gain of airspeed in a shear (tailwind being encountered is 15 kts shearing quickly to 15 kts headwind). These figures appear above glideslope profile.
X = Start of shear.
Y = Reinterception of glideslope after transition period.
100 kts = Pre-entry airspeed.

the speed of sound. At low altitudes these two speeds are far apart but draw closer with increasing altitude, finally merging at the airplane's aerodynamic ceiling. Increased weight and *g* forces narrow the buffet free altitude and speed envelope.

Certain studies used for teaching texts claim "it doesn't matter too much whether it (the a/c) is in a climbing attitude or normal cruise." Clark disagrees, citing the record and pilot reports which indicate most airplanes (jets) were climbing prior to serious upsets. "If one accepts pilot reports as factual as I do," Clark says, "that their planes were pitching up in updrafts even against forward stick, I would then pose a question: If you knew your airplane was exposed to a 20° nose-up pitching movement wouldn't you be in a better position to recover or have less tendency to over-control if you had started from level flight rather than climb attitude?" Since the answer is obviously *"yes," it is important that you do not penetrate a thunderstorm in a climb.*

Pitch cues from instruments other than the artificial horizon can be misleading in turbulence. Some training documents seem to make the basic assumption that all sweptwing jets are inherently statically stable about their pitch axis throughout their wide operating envelope. Clark disagrees, but does agree on the artificial horizon as the most useful instrument.

Clark refers to the Coefficient of Lift curve, Fig. 11. He feels that teaching of the left side only (the stable side) without discussing the curve reversal on the right (unstable) is a major omission. Our military schools and the Russians are quite aware of this instability, he points out.

Tips of sweptwings are normally washed-out (front end lowered) by designers to combat the pitch-up problem. Wash-out to a positive relative wind becomes wash-in to a negative relative wind, a condition which would seem to cause an early negative angle-of-attack wingtip stall. Negative center-of-lift shifts inboard and forward giving a pitch-down moment to the upset airplane, already in a negative *g* mistrim dive, complicating the recovery.

Use of split spoilers on some sweptwing jets can be of great value not only in the conventional dive recovery, but also can be helpful in stopping unwanted pitch-up prior to the upset after all elevator has been used. Spoiler input is easy to remove so there is not "locked in"problem with spoiler mistrim as is possible with stabilizer mistrim, Clark suggests.

HANDLING LOW-LEVEL WINDSHEAR

Clark made a careful study of windshear and arrived at some clear-cut recommendations.

Fig. 16 illustrates Clark's discussion of low level windshear which has always been with us but only recently has received major interest.

Takeoff or landing into known or probable low-level windshear turbulence is extremely dangerous.

Continued on Page 24

airborne emergency results in..

DRY LAKE LANDING

Capt John E. Hemmer
7BMW, Carswell AFB

The mission was scheduled as a simulated EWO tactical training profile from Carswell AFB with an 1130L take off time. The aircraft, a B-52D, was to be piloted by Maj Thurman Chamblee, 7 Bomb Wing simulator instructor, and Capt John E. Hemmer, 7 Bomb Wing flying safety officer. Both pilots were scheduled to receive their annual instructor and instrument checks from Capt James A. Yule, 7 Bomb Wing stan/eval instructor pilot.

Maj Chamblee was occupying the pilot's seat, Capt Hemmer was in the copilot's seat and Capt Yule was in the IP seat. Capt David A. Moser, 20 Bomb Sq, the student radar navigator, was in the radar nav position. Capt Robert L. Hensz, 9 Bomb Sq, was receiving instructor radar navigator training and occupied the navigator's seat. The instructor radar navigator, Capt Charles T. Sober, Jr., 20 Bomb Sq, was in the instructor navigator position. The electronic warfare officer was Capt William L. Richards III, 20 Bomb Sq, and the "aft compartment commander" was MSgt Paul R. Kiviaho, wing gunner, who occupied the gunner's position in the tail. Little did they know that they would become involved with a serious aircraft emergency immediately after takeoff, the first of a kind for the B-52D.

All crew activities up to takeoff had been normal. Maj Chamblee and Capt Hemmer coordinated their takeoff procedures and requested takeoff clearance. The weather was clear, visibility unlimited, and the winds were down the runway. It looked like it was going to be a good day.

The aircraft was cleared for takeoff. From the number one position, a rolling takeoff was initiated and takeoff power was set as the aircraft lined up

Editor's Note: The story that Capt Hemmer relates is a clear reflection of the superb competence and productive teamwork that exists in the SAC crew force today. On 28 May 1976, Lt Gen Hoban awarded Air Medals to Capt Yule and Capt Hemmer. In addition, Gen Hoban awarded Air Force Commendation Medals to Maj Chamblee, Capt Moser, Capt Hensz, Capt Richards, Capt Sober and MSgt Kiviaho for their participation in the flight.

with the runway. Power and time checks were good and the aircraft broke ground at the precomputed distance. Maj Chamblee raised the gear handle and then the troubles began.

The four main gear and the two tip protection gear broke lock and started up. Each gear is independently operated by its own hydraulic power pack and system. The aft gear and the tip gear retracted to the up and locked position. The two forward gear, however, got about half-way up and then started back down. Capt Moser, who was monitoring the retraction through the optical bomb sight, alerted the pilots of this fact and, simultaneously, Maj Chamblee noted the illumination of the master hydraulic warning light and the systems one and two hydraulic failure lights. Within seconds, Capt Richards had his tech order open to the hydraulic emergency procedures section. The flaps were left down and a climb was continued to 10,000 feet.

Since the hydraulic control panel was located on the pilot's side panel, Maj Chamblee transferred control of the aircraft to Capt Hemmer and initiated the Landing Gear Failure to Retract checklist as Capt Richards read off the items. Capt Hemmer aborted the mission and requested holding instructions at 10,000 feet. Using the checklist procedures, Maj Chamblee was unable to rebuild hydraulic pressure using either the primary hydraulic power packs or the electrical standby pumps on systems one and two. Under normal circumstances with loss of pressure on only one gear, pressure can be crossed over from the adjacent gear system to provide gear extension and retraction. With both systems one and two pressures at zero, there was no crossover capability since each was the backup of the other.

After leveling at 10,000 feet, it was decided to make a visual inspection of the wheel well area to confirm what the crew already feared. The crew compartment was depressurized and Capt Yule left the compartment through the alternator deck access door to inspect the wheel well. The wheel well area was hydraulic fluid from top to bottom and the gear were in the positions indicated in the cockpit, left forward down and locked and right forward intermediate. Since the left forward gear moves aft and down in its extension cycle, the slip stream had helped in pushing it aft and down to the locked position. However, since the right forward gear moved forward and down in its extension cycle, the slip stream in this case was preventing the gear from moving forward and down to its locked position. The free weight of the gear falling down due to gravity was not sufficient to overcome the slip stream.

At this point a Hotel Conference was established with the Carswell AFB command post and supervisory personnel were notified. Higher headquarters personnel were notified and Boeing Aircraft engineers were plugged into the conference. The gravity of the situation was this: no ground steering except for cross-wind crab control of the rear gear, no braking, the right forward gear in the intermediate position, the left forward gear down and locked but only being held there by the over center lock, and no air refueling capability since the air refueling doors were operated by the same two hydraulic systems. Because the event occurred immediately after takeoff, there was no critical fuel situation and the loss of the air refueling capability did not present any immediate danger. But sooner or later the bird had to come down—on crippled legs.

It was decided that the aircraft would divert to Edwards AFB for landing on the 5.9 mile long dry lake bed. A flight plan, quickly drawn up by Capt Moser and Capt Hensz, was filed in flight and the trip to Edwards commenced.

But the problems weren't over yet. There were several aspects of the impending landing that had to be considered. What if the dragging right forward gear caused the aircraft to ground loop? What if the forward gear started to shimmy and vibrate due to the loss of hydraulic fluid for dampening? Would it cause structural damage? Should steering with the crosswind crab on the rear gear be attempted? This is a critical maneuver and could easily ground loop the aircraft if too much were applied. What if the left forward gear, only held down by the over center lock, collapsed and allowed the aircraft to go skidding on its nose? In this case the crew would have to use the overhead escape hatches and escape ropes since the normal crew entry hatch was under the nose. Should the gear safety pin on the left forward gear be installed in flight? What about landing in the middle of a dry lake bed, a feat never accomplished by any of the pilots and considered tricky due to loss of depth perception?

During the two and one-half hour flight to Edwards, radio contact with the Carswell command post was maintained and all these questions were discussed. It was decided that no attempt would be made to install the left forward gear safety pin since it was a remote possibility that the over center lock would fail. The wheel well area was slick with hydraulic fluid and a far greater danger existed in that a crewmember might prematurely depart the aircraft in an effort to traverse an open wheel well. To prevent shimmy and vibration on landing, it was decided that no steering inputs of any kind would be made unless it became imperative to attempt it through the crosswind crab on the rear gear. This would prevent the depletion of any fluid that might be left in the steering cylinders and allow it to provide some dampening of vibrations or shimmy. In the event that the aircraft might skid on its nose, the upward ground egress procedures were reviewed. Each of the escape rope cannisters were opened and the ropes checked to insure they were properly secured. Captain Yule reviewed with MSgt Kiviaho his procedures of jettisoning the gunnery turret and exiting the aircraft. A chase aircraft, an A-37, would be launched at Edwards when the aircraft arrived to aid in the depth perception problem. The Carswell AFB Wing Commander, Col. David E. Blais, having determined that Capt Yule and Capt Hemmer were the most current of the three pilots, directed that they would occupy the pilots' seats during the landing and that Capt Yule would actually make the landing.

After reviewing these procedures and making the necessary seat changes, the aircraft shortly thereafter arrived over the Edwards AFB dry lake. Upon arrival the chase aircraft was launched and joined up with the disabled B-52.

The telephone/radio conference that had been established initially over Carswell was already reestablished upon arrival through the Flight Test Center command post. The crash equipment and photo lab personnel were already pre-positioned along the intended landing path. Both the chase aircraft and the Flight Test Center command post were each manned with a test pilot that had prior B-52 experience.

Since the aircraft had not yet burned down fuel to the quantity desired for the landing, practice low approaches were made to the lake bed with the chase aircraft on the wing giving altitude information. After about a half dozen low approaches and the fuel quantity being at the desired level, the crew felt that they were ready. It was "clear and a million" and they would be landing directly into a 20 knot headwind.

It was about five and one quarter hours from takeoff when the last approach for the intended landing was started. It had been filled with a vast amount of communication, discussion, and coordination and was about to come to a climax. The final approach looked good and the crew felt prepared for any eventuality. It felt like a normal touchdown to the crew with a slight skip at first and then the aircraft touched down and stayed on the ground. The chase aircraft reported that the right forward gear, which was free swinging, began to flop as it would contact the ground and then bounce into the air. Fortunately there was no unusual vibration or control problem that the crew could detect. The left forward gear over center lock was staying locked. The drag chute was deployed and as the aircraft speed decreased and more weight was put on the wheels, the aircraft began to heel over on the right tip gear because of the lack of support from the right forward main gear. The aircraft started on a curving landing path to the left. Since the crash equipment was located off to the left, Capt Yule introduced a small amount of crosswind crab to the rear gear to bring the aircraft back to the right.

When the aircraft came to a stop, it had traveled about 2½ miles from the threshold of the lake bed. The left forward gear had held and the structural integrity of the aircraft had not been damaged. The left forward gear safety pin was dropped out the copilot's window to ground crew personnel who immediately installed it. The normal crew entry hatch was opened and a happy crew deplaned for a short TDY in California.

ABOUT THE AUTHOR

Capt John E. Hemmer, a 7BMW flying safety officer, served in Vietnam in the C-7A. He also saw action over Hanoi as a B-52 A/C during Linebacker II. He is IP qualified in the B-52D and has held assignments in the RTU and the 7BMW Stan/Eval Division. He was also qualified in the KC-135. Capt Hemmer has a B.S. degree in mechanical engineering from the University of Missouri and an MS degree from Texas Christian.

SELM TEST

Continued from Page 9

weeks to complete. Over 7,000 man-hours are involved in the work performed by maintenance, inspection, and security teams. This does not include time spent in training, advance planning, or the work of the missile crews.

What do we learn in return for the time and money spent on SELM? A more common and particular question is what do we learn from SELM that we can't learn from launching missiles at Vandenberg? The answer to both questions is obvious when one is familiar with each of the testing programs.

At Vandenberg, a missile is launched on a trajectory over the Pacific Ocean. The missile has been randomly selected from those normally on alert in the field. Frequently, the missile is one that has been on alert, day in and day out, for years. It's launch at Vandenberg is a test of that missile's propulsion, guidance, and re-entry systems. Much valuable data has been — and continues to be — obtained from these launches. It is data which simply could not be obtained any other way.

We must know more about our missile force, however. We must be sure that equipment we have buried under the plains of Wyoming and Nebraska, and elsewhere in the Continental United States, will perform as designed.

For example, during last year's (1975) SELM at Warren AFB, one of the specific objectives of that test was to confirm that the 110-ton launcher closure door would open during the missile's terminal countdown. During the test, one launcher closure door was "blown" from the top of the launcher tube. This massive slab of steel and concrete rolled quickly down tracks for about ten feet, until it was stopped by about 65,000 lbs. of sandbags. At that point, we had confirmed that the launcher closure doors and their activation systems — which have been stationary sometimes for years (and in all types of weather) — will activate at the required moment.

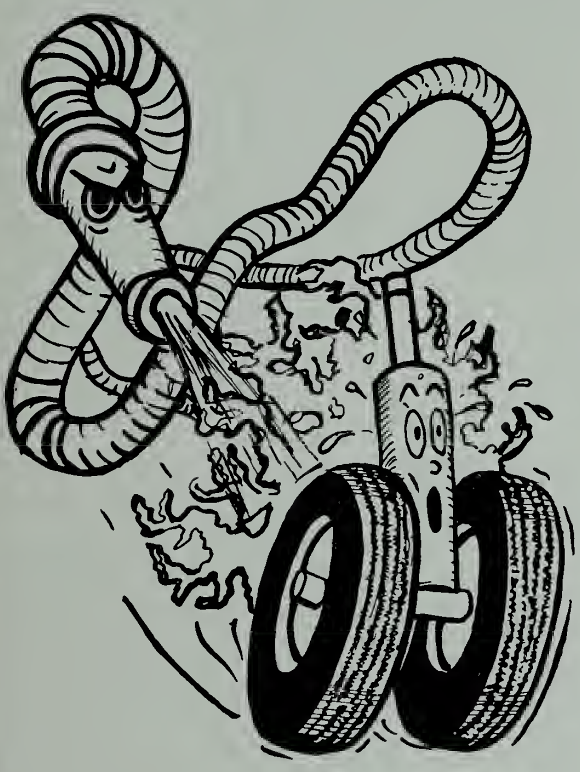
This year, no launcher closure door was opened, but one of our SELM tests specific objectives was to test the lateral restraint system which holds the missile in the silo and protects it from shock and vibration. We wanted to confirm that elements of the restraint system would pull away from the missile during its terminal countdown.

The test of the lateral restraint system was only one of seven specific objectives of this year's SELM test at Warren AFB. In the future, with each SELM test accomplished here at the 90th Wing, SAC will test a different squadron. At the same time, we will be confirming the many and sophisticated capabilities of the Minuteman III weapon system.

Similar SELM tests have been and will be accomplished at the five other Minuteman bases. Each test will continue to have it's own list of specific objectives and will test the operational equipment in place at those bases.

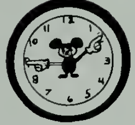
During the last two years, the SELM program has been successful in its objectives and has confirmed the capabilities and launch reliability of this country's Minuteman force.

OPS HAZARDS



HOT BREAKS — During a B-52D pilot's first solo flight, the takeoff was aborted for failure to attain S_1 speed. Brake energy after abort was computed in the caution range at 155 million foot pounds. The fire department was called as a result of the possibility of hot brakes. About 15 minutes after the abort a brake specialist advised the crew that number two brake was hot. The crew shut down, released the brakes and deplaned. Further checks revealed all eight brakes had fused and required removal and replacement.

Information from past such occurrences indicates that if brakes are set and held with the brake energy limits in or near the caution range until they cool, they frequently will fuse. So — if you abort, get chocks in place and release the brakes to prevent such fusing and the resultant added cost and man-hours for brake replacement.



OUT BASKET

Weather Support Change — Pilot weather briefings should be enhanced by changes that will take place later this year in the CONUS base weather stations. A new weather communications system will replace the old teletype networks for delivery of weather reports and forecasts. Implementation of the new system, the CONUS Meteorological Data System (COMEDS) began in Texas in early July 1976. The entire COMEDS system is scheduled to be complete by Dec 1976. It will operate at 1200 words per minute and all network operations will be controlled by a computer located at Carswell AFB. Terminals in the weather station will consist of a page copy printer, a keyboard and an electronic screen visual display.

This new system will impact the forecaster/briefer routines and the amount of weather data displayed. As a result, far fewer files of "teletype sequences" will be posted in the weather station. Chances are that the weather report or forecast you wish to see or use during your briefing won't be there. In this event the forecaster/briefer will query the central data file in the Carswell computer by punching a few keys on the terminal of the new communications system and in a few seconds the information you need will be flashed on an electronic screen similar to your TV picture screen. This "soft copy" not only will save time and resources in the weather station it will also insure that you are getting the latest weather information in the system.

1976 SAC Safety Seminar — The 1976 SAC Safety Seminar will be held at Carswell AFB on 19-21 October. Two days (18 and 22 Oct) are planned for travel to and from Carswell. HQ SAC Project Officer is Maj Robert A. White HQ SAC/DOSG AV 271-2610/4580. The seminar program and agenda items are being formulated and will be released in the near future. Again this year, Operations Training Support Laboratory (OTSL) will be the host organization at Carswell.

BIG INSTRUMENT

VISIBILITY – TO LAND OR NOT TO LAND

Captain John L. Wilson
1st Combat Evaluation Group
Barksdale AFB LA

VISIBILITY — The state or fact of being visible. The relative ability to be seen under given conditions of distance, light, atmosphere, etc.

METEOROLOGY: The distance at which a given standard object can be seen and identified with the unaided eye.

In today's all-weather aircraft, almost all maneuvers required during a mission can be done without visual reference to the ground. It is within our capability to navigate, fly low level, and even bomb the target strictly with reference to the aircraft instruments. The area that still requires outside reference is takeoff and landing. The required landing visibility is not much, the minimum for SAC being 2400 feet (½ statute mile). While traveling at a rate of two to three miles per minute (120 — 180K) however, very little time is available to determine your position in relation to the runway and decide if a safe landing can be made.

This is the first of a series of articles that will explore the area of minimum visibility landings. This series will include such areas as weather phenomena that restrict visibility, lighting systems, how the regs and manuals affect SAC operations, what you may expect to see at "minimums," how to plan for low visibility approaches, and some crew techniques you may want to employ.

WEATHER

There are many types of weather, each with a different effect on visibility. An understanding of the various types of weather and how it appears on a weather sequence will tell a lot about how well you can see to land. For more information on weather and its effects you should refer to AFM 51-12, Weather for Aircrews; AFM 51-37, Instrument Flying (Chapter 18, Landing from Instrument Approaches); and FLIP GP, Chapter 8 (Meteorological Data).

Fog is the most common and persistent hazard encountered in aviation and is the most frequent cause for visibilities less than three miles. It can form rapidly and persist for long periods of time. The following four conditions must be present for fog to form:

(1) A high humidity (indicated by a low temperature-dew point spread).

(2) Something for the moisture in the air to condense on (dust, smoke, etc.).

(3) Relatively light winds.

(4) Some form of cooling process.

There are different classifications of fog depending on the mechanics of the forming process, but the visual effects are all very similar. Visual cues can be difficult to pick out, they are easily lost, and there is the possibility of becoming disoriented if the visual cues are misidentified. To be properly prepared, a thorough analysis of the weather sequence along with an understanding of the effects that can be encountered is important.

Weather reports for fog will often indicate a partially obscured condition. Partially obscured means that at least one-tenth but less than all of the sky is hidden from the weather observer. Since the observer can see part of the sky he will report the bases of any clouds that are present. What you do not know is how much of the sky is obscured or where the fog is in relation to the runway. The amount of sky that is obscured is available but not normally transmitted over the radio. This information is in the remarks portion of the weather sequence and gives the amount of sky, in tenths, that is obscured. You will have to ask for this information when you get the landing weather. It is important since it gives you an idea of what conditions to expect. For instance, if nine-tenths of the sky is obscured you could expect low visibility on final, whereas, if one-tenth is obscured relatively good visibility could be expected (unless, of course, the one-tenth happens to be on final approach).

The reported visibility is of course vital information, but in partially obscured conditions it can be misleading. Prevailing visibility is the greatest distance the observer can see objects throughout at least half the horizon. This could lead to a reported visibility that is quite different from what you actually encounter on final approach. RVR information, if available, may give more representative visibility information, but it again depends on where the fog is in relation to the measuring equipment. The RVR equipment only gives information on the visibility that exists at the measurement location. Consider the following weather reports: 1. -X 1F . . . . R18VR24; 2. -X 1/2GF . . . . R18VR24; 3. -X 1F . . . . R18VR50. The first, although typical, appears to be incorrect since the prevailing visibility is one mile but the RVR indicates the visibility is ½ mile. What it gives you is an idea of where the fog is. The second sequence has prevailing visibility and RVR information that agree. How about the third sequence? Looks good, and normally no problems would be encountered on the approach. The fact still remains, though, that there is fog that obscures part of the sky. It is not covering more than half the sky since the visibility is not too bad and it is not around the RVR equipment, but you could still encounter the fog on final approach and not be able to see the runway environment. Maybe not a likely occurrence but something you should be prepared for. Here again, the remarks could help explain this phenomena.

A shallow fog (usually no more than 200 feet thick) could also be misleading by what you observe from the cockpit window. Under these conditions, the runway and approach lights may be visible on final approach. As you enter the fog layer however, visual reference may be lost, and if not prepared you may become disoriented. It can be a real surprise to arrive at DH seeing the runway and as you continue your descent for landing lose most or all of your visual references.

A totally obscured condition presents a different weather report and a different set of circumstances. When a totally obscured condition is reported the amount of vertical distance the observer can see is reported (e.g., "indefinite 300 foot obscured"). Keep in mind that as you pass the level of the vertical visibility you will not be able to see the runway like you can as you pass the level of a cloud base. As you pass the reported observation level you may be able to see the ground directly below your aircraft, but probably not see the runway until considerably below that level. The prevailing visibility and RVR information should be fairly close to each other, but variations can exist due to the methods of taking the readings and where the readings are taken.

When fogs are encountered, winds are normally light or calm, making precise instrument flying easier. With advection fogs, however, winds of up to 15 knots can be encountered. Add a 15-knot crosswind to the low visibility and the landing can become quite demanding. Turbulence will often be encountered, making precise aircraft control and instrument crosschecks difficult. With a crosswind present, the runway will be sighted off to one side of the aircraft nose and crosswind or crab removal techniques will have to be used during landing.

Precipitation (drizzle, rain, snow) will also reduce visibility although usually not to the extent that fog does. Extremely heavy rain or snow showers can reduce visibility to zero, but this condition is usually of short duration. Water streaming over the windshield can reduce the effective visibility considerably below that reported by the weather observer. Under heavy rain conditions, water on the windshield can refract light, causing the ground to appear in a position different from where it actually is. Lights and ground objects will become blurred and indistinct. Add these effects with turbulence and crosswinds that are often encountered, and the approach and landing can become quite difficult. Snow on the ground can hide objects, reducing depth perception. The effect of snow streaming past the aircraft, particularly at night with the landing lights on, can have a blinding and distraction effect, making visual flight difficult.

Haze, smoke, dust, and smog can present serious visibility problems. The reported prevailing visibility will probably be fairly good, but what is observed from the cockpit due to lighting conditions can be almost as bad as fog. The worst time is when making approaches into the sun around sunrise or sunset. The brightness of the sun, lack of contrast, and seeming darkness on the ground make for extreme difficulty in sighting the runway.

These various restrictions to visibility can, of course, occur simultaneously, like fog and drizzle, or rain and smoke. There are many variables and there are times when the conditions you observe will vary considerably from that reported. Analyzing the weather reports goes beyond just determining if the field is above or below minimums. You must try to form a mental picture of what to expect and then plan for the unexpected. Keep position oriented and have enough of an instrument crosscheck going to be able to revert back to total instrument flying on a moment's notice. An understanding of weather phenomenon, how it affects visibility, and how it is reported is the place to start planning for low visibility approaches.

TURBULENCE TECHNIQUE

Continued from Page 15

Clark referred to Fig. 16 (windshear action on an approach) in explaining the results of shear. Plane is shown in stable descent prior to shear entry, with vertical component of lift slightly less than aircraft weight.

Flying from headwind into tailwind in the example an assumed pre-entry speed of 100 kts is used. Headwind encountered is 15 kts shearing quickly to 15 kts tailwind temporarily reducing airspeed to 70 kts. Airspeed loss is 30 kts or 30%, but lift drops a whopping 51% which in turn causes a dangerous loss of altitude. Since shears are typically associated with thunderstorms any heavy precip reduces visibility and falling rain caused downdrafts which increase the dangerous rate of descent.

OPTIONS TO INCREASE LIFT IN WINDSHEAR CONDITIONS

Options to increase lift are limited. Four things are multiplied to calculate lift: Coefficient of lift, C_L, ½d (air density), V^2 velocity squared, and wing area, S. Lift = C_Lx ½d x V^2 x S. $C_L$is a number describing how hard the wing is working to produce lift. It can be raised by increasing angle of attack to just short of a stall. In this example the option is limited because a normal approach is made close to the stall angle of attack.

Density of air cannot be controlled by the pilot and wing area has already been increased by flap extension prior to final approach. Therefore V^2, true airspeed, must be increased immediately by adding power to avoid ground contact. In the formula V is squared which makes it a powerful factor. All other factors are linear or nearly so except when C_L reverses at stall. In the example pre-shear V is 100. V^2 is 10,000. Post shear V^2 = 4900 or 49% of original lift. Power added to a prop plane quickly increases lift by increasing air-flow over the wing. Jet thrust, however, must be translated into increased airspeed of the entire plane before lift is increased.

Altitude is lost while thrust is acting to accelerate the plane from the 70 kts A/S back to 100 kts and plane drops below G/S. Descent is gradually shallowed allowing reinterception of the G/S from below.

Here the second problem enters. Plane is back on G/S. A/S is 100 kts. Groundspeed has now moved from original 85 kts to 115 kts and a higher sink rate is needed to fly the normal approach profile. Higher sink rate will increase airspeed requiring reduction of power. There is now a distinct possibility of overshoot or go-around. Knowledge of the existence or possibility of headwind-to-tailwind shear prior to approach would clue the pilot to pad his air-speed prior to penetration. Cushion of added airspeed adds to overshoot tendency. However in terms of priorities it is imperative to avoid a stall or ground contact short of the runway. Clark's words: "Deal with overshoot later. Fly now — overshoot later."

With the reverse situation, flying from a tail-wind into a headwind, power is low to maintain the G/S profile. At transition while adjustments are made to compensate for the new headwind and decreased groundspeed there is a need for more power, promptly applied, or undershoot may result.

Clark questions recent reaction to windshear accidents which suggest transferring decision-making to ATC. Decision to divert, delay or penetrate is the key to safety, he contends. He believes the pilot is best qualified to make this decision. But he must be thoroughly trained and must have received the information necessary to make the decision. This information should be specific. If other pilots report shear they should state whether airspeed increased at shear entry, or did it decrease? Decrease in airspeed is more dramatic and immediately dangerous of the two types of shear discussed.

Summary of the problem suggests one should avoid low level windshear if operationally possible. If unavoidable, carry an airspeed cushion to avoid ever getting behind the thrust-available / thrust-required curve. Low airspeeds at high angles of attack are especially dangerous in headwind to tailwind shear. Power and altitude corrections immediately after airspeed changes can be expected to reverse after plane is stabilized in the new wind system, regardless of whether the airspeed increases or decreases in the shear.

WAKE TURBULENCE FACTORS

Factors which should be thoroughly ingrained in each pilot's technique by adequate training were itemized and discussed by Clark:

Downwash: Newton's third law of motion states that for every action there is an equal in magnitude and opposite in direction reaction. Airplane generating life creates an equal and opposite downwash element.

Wingtip vortices: High pressure air from beneath the wing flows around the wingtips toward low pressure area on top of the wing. Looking forward, the circular air motion or vortex will be clockwise around the left wingtip, counterclockwise around the right wingtip.

Magnitude: When the angle of attack is large on a heavy airplane, as on takeoff rotation, lift and downwash are very large. Wingtip vortices are intense.

Time lag: Wake turbulence dissipates with time. Still air and certain temperature conditions may delay dissipation a surprisingly long time.

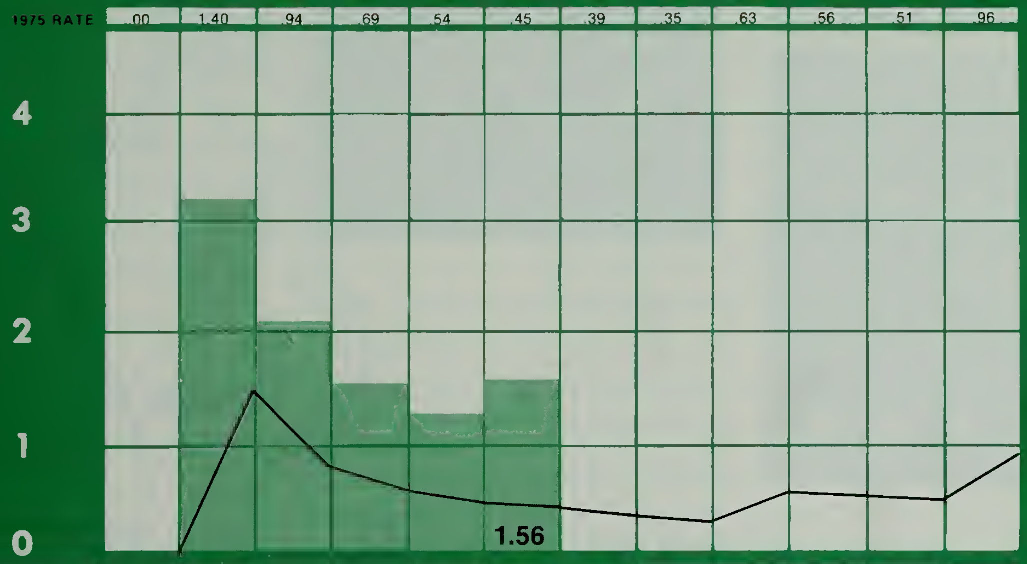
Comparative wing spans: Control problem increases when penetrating airplane has the smaller wing span. Total wing span of the following plane could be in either left or right vortice, or in downwash between the vortex cores, causing violent gyrations.

Wind currents: Wake turbulence descends slowly and moves with the wind. This drift can be visualized and spacing gap can be shortened or moved left or right if there is a strong crosswind.

Solution: Know the location of wake turbulence and avoid it. Beware of minimum speed and maximum angle of attack entries.

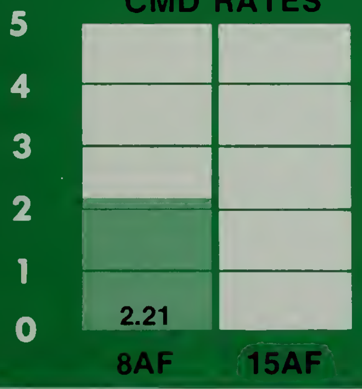
1976 Flying Safety Rate

SAC MAJOR ACCIDENT RATE (PER 100,000 FLYING HRS)



ACCIDENTS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1975	0	1	0	0	0	0	0	0	1	0	0	2
1976	0	2	0	0	0	1						

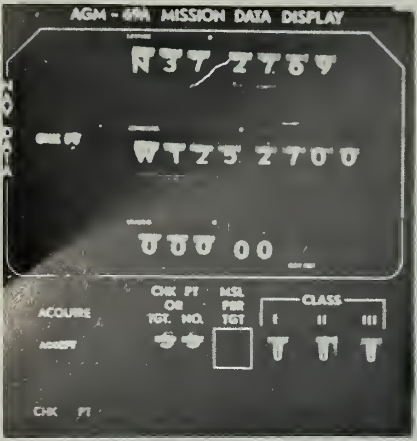
1976 SUBORDINATE CMD RATES

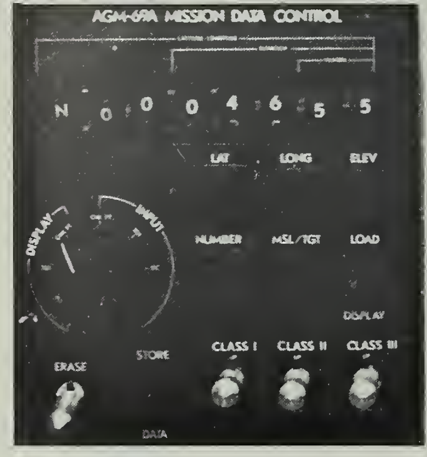


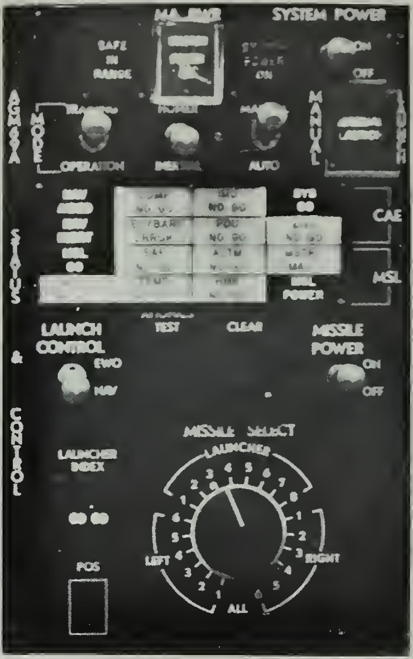
ACCIDENT STATUS

KC-135	FEB 76
FB-111	FEB 76
FB-111	JUN 76

LEGEND ⌒ =1975 RATE







SRAM

Continued from Page 7

Display button on the Mission Data Control Panel. With the Radar Target mode selected, the coordinates of the BNS crosshairs, as calculated by SRAM, will be displayed on the Mission Data Display Panel. After waiting a minimum of 60 seconds the Load Display button is depressed again and the crosshairs are moved until the coordinates displayed match the previously recorded values. This procedure can be used even if the B-52 radar has failed since it is not necessary to see either the crosshairs or aiming point.

The second method of wind determination can be used if both the Doppler and memory point winds are unreliable. The procedure requires addressing SRAM computer specific memory locations using a system instruction code. The SRAM calculated east velocity component is displayed and recorded. The BNS east velocity component is then displayed continuously and can be increased or decreased using the BNS Emergency Set Control Panel. When the BNS component matches the recorded SRAM value, the BNS east velocity has now been updated using the SRAM east velocity component. The same procedure is repeated for the north velocity component.

Finally, the CAE can be used by the navigators to validate the position of the BNS crosshairs prior to updating the BNS present position and thereby instill confidence in radar scope interpretation. Many returns appear similar when attempting to interpret a radar scope, but the SRAM system will confirm whether or not the analysis of the scope is correct prior to updating the BNS computers on the return.

Next, equal time should be given to analyzing the SRAM assistance available to B-52 radar navigators during bomb runs. The inertial heading of the CAE displayed on the Mission Data Display Panel when interrogating the Position/Heading mode is not subject to magnetic anomalies or false celestial lock-ons. Consequently, this heading information is of tremendous value as a back up for terrestrial heading checks as determined using aiming points offset from the target.

In addition, the target area can be identified using the SRAM "Sharkey" technique. The BNS crosshairs are manually driven to the target area and checked for proper readout. If the crosshairs do not read the correct coordinates, they are moved, "Sharkied", so they will give the proper readout. However, one significant difference is that the "Sharkey" bomb run can be successfully accomplished without both ground mapping radar or BNS computers. The target must be within 17½ miles from the aircraft position and the RADAR/TARGET MODE must be selected with the Load Display button depressed. Then, with the BNS tracking handle, keep moving the crosshairs until the target coordinates are being displayed on the Mission Data Display Panel.

The next method in which the SRAM system can serve as a bombing aid is rather complex and would have to be practiced in order to allow sufficient time to complete the bomb run. Once again the memory core of the master computer is addressed in order to obtain the relative bearing and range to target from aircraft position. The desired information is once again displayed in octal form and must be decoded using tables which may take too much time during a Bomb Run.

Flying missions in which the SRAM system is used as a navigation and bombing aid in the B-52 is a rewarding experience. It is a sophisticated weapon system that works for *you* — you do not work for it. The SRAM is, without a doubt, a potent weapon system AND A LOT MORE!!

ABOUT THE AUTHOR

Capt. Stephen M. Ray is a radar navigator assigned to the 34th Bomb Squadron, Beale AFB. He has extensive experience as an Instructor Navigator with flight examiner background in the wing Standardization/Evaluation Division. He is currently being upgraded to Instructor Radar Navigator.

THE OLDER I GET, THE LESS DUMB THINGS I DO.

Experience. Another one of those nebulous concepts, like pride and professionalism, that conjures up all sorts of images in the back of your mind but is difficult to express in words. Ask 100 pilots (or any other crewmember) for their definition of experience and you will come up with at least 101 answers. But the definition I like most from my own flying experience is "The more dumb things I have done, the less dumb things I will do."

In my relatively short flying career, I can look back more or less objectively at some of the not too smart things I have done. I'm not too proud of them but I remember, and will not make the same mistakes again. Images flash through my mind of climbing for the best part of an hour in an unpressurized light transport without oxygen to 13,000 feet to avoid weather in order to deliver cargo that didn't matter. Other flashes show me going into a forward field VFR and shooting a touch and go because the visibility was so bad that I was on the runway before I realized that it was the wrong field. I can also remember shooting short field landings on a 10,000 foot runway to see if I could turn off at the approach end taxiway. Really dumb things when I look back at them, and I'm sure that there are other dumb things that I will do in the future.

Ah Ha! The thought comes to mind that all experience is, is surviving to a ripe old age and making all the mistakes that can be made. Unfortunately, there are a few things wrong with that thought. First, you run a good chance of killing yourself before you get to that ripe old age. Second, if you lived forever, you wouldn't be able to make all the mistakes there are to make, and third, age and flying is not really a good indicator of experience and judgment. Did you ever fly with that hightime instructor pilot who was shooting touch and go's to a 300 foot ceiling with just about enough fuel on board to get half way to the nearest usable alternate? Every base has at least one. Learn from him if he doesn't kill you first.

Well then, what can you do to increase your own experience? Experience is something that you must learn for yourself. Learn from your own mistakes. Don't let yourself believe that there is any such thing as luck. Don't assume that any landing that you can walk away from is a good one. Take a little time to Monday morning quarterback and discover what dumb things you have done. You may only get one chance to commit some mistakes before they kill you. Learn from the mistakes of others, both first and second hand. Spend time analyzing and questioning the aircraft commander and other crew members. You can get some good experience and probably a good war story or two on why they do things as they do. At least that way, when it's your turn to make decisions, you'll have a head start. Listen closely to those war stories at the bar. After 2 or 3 drinks, the basis for most war stories is who did the dumbest things and lived to tell about it. Listen to those mistakes, you might not be as lucky as they were. (Oh what war stories we could hear from those who didn't make it). Learn from your manuals, regulations and tech orders. An experienced old boom operator, that I once knew, made the statement "For every warning in the dash one, someone was killed to get it put in there." Most of those regulations that we all complain about taking away our freedom were written because someone did something dumb.

Just because the average age of the crewforce is getting lower doesn't mean that the experience level has to drop. The 1Lt aircraft commander has as much experience at his fingertips as the Lt Col. All he has to do is seek it out, listen and learn.

There is one advantage of growing old, though, that is wrongly attributed to experience. As the hairline recedes and what is left starts turning gray, your fellow pilots allow you the luxury of acting more conservatively. But that's not experience, that's just plain growing old.

Lt. Col. Anon E. Mouse
509BMW
Pease AFB

PROFESSIONAL PERFORMERS

Individuals selected for these pages as SAC's top professional performers of the month are chosen from nominations made by all SAC units. Selection is made only after all nominations have been carefully screened and those chosen meet the highest standards of excellence as outlined in SACM 127-2.

FLYING CREW

28BMW, Ellsworth Crew E-10: P Capt Raymond C. Bishop, CP Capt David R. Christensen, EWO 1Lt Brent C. Brown, CP Capt Homer N. Rhodes; kneeling, L-R: G Sgt Brad A. Worthington, RN 1Lt Jerry L. Helmen, and N Capt Robert H. Montgomery.

MINUTEMAN Crew R-161, 321SMW, Grand Forks AFB: MCCC 1Lt Charles D. Weber, and DMCCC 2Lt George T. O'Neal.

MAINTENANCE MAN MSgt James J. Kovach, III, 42 OMS, 42BMW, Loring Air Force Base.

TITAN Crew S-206, 381SMW, McConnell AFB: MCCC Capt Ellery E. Baker, DMCCC 1Lt Ronnie P. Ruiz, BMAT SSgt Herman E. Dumke, Jr., and MFT SSgt Danny R. Furniss.

HALL OF FAME

TACTICAL FLYING

OVER SIXTEEN YEARS

916 AREFS, Travis	Sep '59
97 BMW, Blytheville	Mar '60

OVER FIFTEEN YEARS

410 BMW, K. I. Sawyer	Oct '60
19 BMW, Robins	Oct '60

OVER FOURTEEN YEARS

11 AREFS, Altus	Feb '62
301 AREFW, Rickenbacker	Jul '62

OVER THIRTEEN YEARS

96 BMW, Dyess	Aug '62
449 BMW, Kincheloe	Aug '62

OVER ELEVEN YEARS

320 BMW, Mather	Jul '65

OVER NINE YEARS

92 BMW, Fairchild	Feb '67
55 SRW, Offutt	Jul '67

OVER EIGHT YEARS

2 BMW, Barksdale	Aug '67
319 BMW, Grand Forks	Dec '67
22 BMW, March	Feb '68

OVER SEVEN YEARS

5 BMW, Minot	Feb '69

OVER SIX YEARS

42 BMW, Loring	Oct '69
93 BMW, Castle	Nov '69
28 BMW, Ellsworth	May '70

OVER FOUR YEARS

7 BMW, Carswell	Mar '72
416 BMW, Griffiss	May '72

ICBM

OVER TWELVE YEARS

381 SMW, McConnell	Nov '63
90 SMW, F. E. Warren	July '64

OVER ELEVEN YEARS

1 STRAD, Vandenberg	Sep '64

OVER TEN YEARS

308 SMW, Little Rock	Aug '65

To gain listing in the Hall of Fame, a SAC unit must be accident-free for 48 months.

SAC Safety Screen

The SAC Safety Screen is an honor roll of SAC's most professional crews. To gain listing on the Screen, crew members must be nominated by their unit commanders and meet high selection criteria of experience in their aircraft or missile system *IAW SACR 127-2.*

9SRW, Beale Crew S-13: P Maj Leland B Ransom II, RSO Maj Allen R Payne
17 BMW, Beale Crew E-17: P Capt Richard D Lee, CP 1Lt Robert Bledsoe, CP 1Lt Terry J Nielsen, RN Capt David M Salter, NN 1Lt Manuele F Crivello, EW 1Lt Charles L Minard, AG Sgt Ronald J Heilman
28BMW, Ellsworth Crew R-132: P Capt Paul Ciaccia, CP 1Lt Richard L Jackson, NN 2Lt Robert E Erdahl Jr, IB SSgt Anthony Haas Jr
93BMW, Castle Crew IT-23: IP Capt Thomas A Robertson Jr, IB Capt George Sevick, IE Maj Theodore Lesher, IS SSgt Dale R Craft
319BMW, Grand Forks Crew S-02: P Capt Richard P Amisano, CP 1Lt Bruce C Grant, CP 1Lt James D Eakin III, RN 1Lt Raymond A Yost, NN 1Lt John D Orr Jr, EW Capt Steven E Johnson, AG Sgt Dan L Morgan
320BMW, Mather Crew R-104: P Capt John C Moore, CP 1Lt John E Vice, NN Capt Stephen P Jacobs, BO SSgt Stanley K Nosik
380BMW, Plattsburgh Crew R-156: P Capt Donald E McKelvey Jr, CP 1Lt Duncan B McIntosh, IN Capt Brian C Johnson, BO Sgt George S Bell
305AREFW, Grissom Crew R-111: P Capt Harry A Bryson, CP 1Lt Robert A Harris Jr, N 2Lt Frank H Rasmussen, BO Sgt Eugene A Schilling
384AREFW, McConnell Crew R-166: AC Capt Wayne K Taylor, CP 1Lt Jackie L Foster, NN Capt James L Hansen, BO CMSgt Joseph A Lewis
301AREFW, Rickenbacker Crew R-107: P Capt William C Bradford, CP 1Lt James M Anderson, N 1Lt John W Dennis Jr, BO Sgt Eric R Helton
44SMW, Ellsworth Crew R-030: MCCC Capt Thomas R McCarthy, DMCCC 2Lt Gary C Lagassey
90SMW, F E Warren Crew S-076: MCCC 1Lt Steven C Hafner, DMCCC 1Lt Lonnie R Mouser
91SMW, Minot Crew E-029: MCCC Capt Duane J Harings, DMCCC 2Lt Alton Perkins
308SMW, Little Rock Crew S-074: MCCC Capt Bruce A Gilbert, DMCCC 1Lt John A Lee, MSAT SSgt Edward R Renick, MFT SSgt Robert L Sullivan
341SMW, Malmstrom Crew R-052: MCCC Capt Walter H Harris, DMCCC 2Lt Michael P Sullivan
351SMW, Whiteman Crew R-013: MCCC 1Lt Jeffrey A Cameron, DMCCC 2Lt Kenneth A Thornton

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DRIVING RODEO

2Lt Clifford G. Enloe
67SMS, Ellsworth AFB

It has long been generally recognized that safe driving habits are of extreme importance both on and off the job. To the missile combat crewmember, on the job driving safety is absolutely essential — the office (LCF) may be 200 miles from the base. Of course SAC has taken positive steps in the direction of encouraging and enforcing safe driving. Throughout the command, seminars, driving courses, checklists and safe driving awards, are used to emphasize the importance of driving safely.

There is no question that these management tools have helped drivers reduce accidents while on duty and during off-duty travel. However, two members of the 68SMS at Ellsworth have found a new twist for promoting safe driving. On their own initiative, Major George Anderson and Lt Robert Simon designed a 400-yard oval driving course and administered competition between the 66th, 67th, 68th squadrons of the 44SMW, at Ellsworth AFB. The official name given the competition was "Auto Safety Motor Cross Competition," but it was quickly nicknamed the "Driving Rodeo."

The course over which the crew vehicles were driven was marked off with pylons and barrels and included parking and backing evaluations. Contestants were awarded points for their driving expertise in avoiding obstacles while maintaining safe control over the vehicle and staying within the driving lanes. Backing and parking evaluations included the use of a spotter to aid the driver in maintaining control over possible hazardous situations.

The competition was divided into two divisions: Squadron Commanders and Missile Crews. Each driver was accompanied by a safety observer to assist in safe maneuvering through the course.

Results of the competition, based on individual driving crew point totals, found the 67SMS winning the Squadron Commander and Missile Crew Divisions with the 68SMS and 66SMS following closely.

Without a doubt, safe driving cannot be overemphasized; especially in today's Strategic Air Command where millions of miles are traveled each year by combat crews, maintenance teams, security police, and staff personnel.

The "Auto Safety Motor Cross Competition," a unique and innovative new concept, has been cited by the 44SMW as an excellent management tool for developing safer driving habits.